

Evaluating The Benefits of Prefabricated Construction Systems in Enhancing Project Speed, Cost Efficiency, And Quality Control in Modern Building Projects in Lagos, Nigeria

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Abstract The construction industry in Nigeria faces persistent challenges of project delays, cost overruns, and inconsistent quality, particularly in rapidly urbanizing Lagos. Conventional on-site construction methods are constrained by labour inefficiencies, weather dependency, and material wastage. Prefabricated construction systems offer an alternative approach through off-site manufacturing and controlled assembly. This study evaluates the benefits of prefabricated construction systems in enhancing project speed, cost efficiency, and quality control in Lagos. A mixed-methods research design was adopted, combining quantitative data from structured questionnaires administered to 120 construction professionals with qualitative insights from semi-structured interviews. Descriptive and inferential statistics were employed for quantitative analysis, while thematic analysis was used for qualitative responses. Findings reveal that prefabricated construction systems significantly reduce construction duration through parallel off-site production and on-site activities, enhance cost efficiency by minimizing material waste and labour requirements, and improve quality control through standardized manufacturing. However, challenges such as high initial capital investment, limited technical expertise, logistical constraints, and low stakeholder awareness were identified as key barriers to widespread adoption in Lagos. The study concludes that prefabricated construction systems offer substantial performance advantages over conventional methods. It recommends policy support, professional training, and pilot projects to facilitate broader adoption within the Nigerian construction industry

Index Terms- Prefabricated Construction, Project Speed, Cost Efficiency, Quality Control, Lagos, Nigeria

I. INTRODUCTION

The global construction industry faces the imperative to accelerate project delivery, contain escalating costs, and guarantee uncompromising quality standards. Traditional on-site construction methods characterized by sequential processes, extensive labour dependency, and vulnerability to weather and site-specific variables increasingly struggle to meet these concurrent demands (Azhar, 2011; Barbosa et al., 2017). Prefabricated construction systems, encompassing modular units, panelized components, and volumetric assemblies manufactured in controlled factory settings, have emerged as a transformative methodology.

1.1 Background

Prefabrication refers to the off-site manufacturing of building components in controlled factory environments, followed by transportation and assembly on-site (Gibb, 1999). This approach aligns with industrialized building systems principles, emphasizing standardization, mechanization, and process optimization. Advancements in digital design technologies such as Building Information Modelling (BIM) and computer numerical control (CNC) fabrication have further strengthened the feasibility and efficiency of prefabricated construction (Eastman et al., 2011).

Globally, prefabricated construction has gained traction in countries like the United Kingdom, China, and Japan, where housing shortages, labour constraints, and sustainability targets necessitate alternative methods (Pan, Gibb, & Dainty, 2012). In

Lagos State, which requires approximately 500,000 new housing units annually to meet the needs of its over 20 million residents, traditional construction methods are increasingly viewed as slow, expensive, and environmentally unsustainable (Ogunnaiké et al., 2025).

1.2 Problem Statement

Despite documented international success, the adoption of prefabricated construction in Nigeria remains incremental and faces significant barriers (Afolabi et al., 2018; Odesola & Ugochukwu, 2015). Modern building projects continue to experience prolonged project durations, escalating and unpredictable costs, inconsistent quality output, and safety and waste management concerns. A critical research gap exists in comprehensively evaluating how prefabricated systems specifically address the triad of speed, cost, and quality within a unified framework, particularly in contexts with developing supply chains and regulatory environments.

1.3 Aim and Objectives

Aim: To evaluate the benefits of prefabricated construction systems in enhancing project speed, cost efficiency, and quality control in modern building projects in Lagos, Nigeria.

Objectives:

- I. Examine the concept, typologies, and operational principles of prefabricated construction systems
- II. Assess the influence of prefabricated construction on project speed and delivery timelines
- III. Evaluate the cost efficiency of prefabricated construction systems compared with conventional methods
- IV. Analyze the effectiveness of prefabrication in improving quality control, accuracy, and consistency
- V. Identify challenges affecting the adoption and implementation of prefabricated construction systems

1.4 Research Questions

- I. What are the fundamental characteristics and types of prefabricated construction systems?
- II. How does prefabrication affect project speed and construction duration?

- III. To what extent do prefabricated systems enhance cost efficiency?
- IV. How effective are prefabricated systems in ensuring quality control?
- V. What factors constrain the widespread adoption of prefabricated construction?



II. LITERATURE REVIEW

2.1 Conceptual Review and Typologies

Prefabricated construction systems represent a paradigm shift from traditional methodologies, relocating building processes from the construction site to controlled manufacturing environments. This approach is rooted in industrialization principles standardization, repetition, and process optimization (Gibb, 1999).

Three major typologies exist (Ogunnaiké et al., 2025):

- I. **Modular Construction Systems:** Three-dimensional volumetric units (entire rooms) fully finished with fixtures and services pre-installed. Offers highest level of off-site completion.
- II. **Panelized Construction Systems:** Flat, pre-assembled building elements (wall panels, floor cassettes, roof panels) with integrated insulation and service conduits. Offers significant design flexibility.
- III. **Hybrid Prefabrication:** Strategic combination of different prefabricated systems or integration with traditional methods for pragmatic, adaptable solutions.

2.2 Theoretical Framework

Industrialized Building Systems (IBS) Theory: Conceptualizes construction as a

manufacturing-oriented process characterized by component standardization, stakeholder integration, and technology utilization (Gibb, 1999).

Design for Manufacture and Assembly (DfMA): A design philosophy prioritizing ease of manufacturing and simplicity of on-site assembly during the initial design phase, enabling efficient factory production and quick, error-free connection on-site (Pan et al., 2018).

2.3 Empirical Review

Empirical research consistently reports significant schedule compression from prefabrication, with Blismas et al. (2006) finding reductions of 30–50% due to concurrent factory and site activities. Regarding cost, while initial material costs can be higher, Jaillon and Poon (2008) demonstrate lower overall costs from reduced labour requirements and material waste (15–20% less). Lawson et al. (2014) document that factory production leads to higher dimensional precision and significantly lower defect rates compared to on-site construction.

2.4 Benefits

Project Speed: Prefabrication enables parallelization while site preparation proceeds on-site, components are manufactured simultaneously, eliminating sequential dependencies and reducing construction duration.

Cost Efficiency: Factory production enables bulk material purchasing, precise cutting, and optimized resource use, reducing material waste. Reduced on-site time lowers skilled labour, site supervision, and security costs, yielding a favourable life-cycle cost profile (Tam et al., 2007).

Quality Control: Factory conditions eliminate weather effects on materials and workmanship. Production using jigs and automated machinery ensures dimensional accuracy, while structured quality assurance enables defect identification before shipment (Nadim & Goulding, 2011).

2.5 Challenges to Adoption

Barriers include high initial capital investment, logistical complexities in transporting large modules, shortage of technical expertise in DfMA and digital

design integration, cultural resistance viewing prefabricated buildings as inferior, and regulatory frameworks not adapted to accommodate prefabricated methods (Goodier & Gibb, 2007; Pan et al., 2012).

2.6 Prefabrication in Nigeria and Lagos

Adoption in Nigeria remains nascent, with application sporadic in luxury residential developments, corporate buildings, and institutional facilities. Limited local manufacturing capacity for sophisticated components exists, and no coherent national or state-level policy framework promotes industrialized construction.

III. METHODOLOGY

3.1 Research Design

A mixed-methods convergent parallel design was employed, involving concurrent collection and analysis of quantitative and qualitative data with findings integrated during interpretation (Creswell & Plano Clark, 2017).

3.2 Population and Sampling

The target population comprised construction professionals in Lagos. A combination of purposive and snowball sampling was used. The quantitative survey targeted 120 respondents across four stakeholder groups: Architects/Engineers (32%), Contractors (30%), Project/Facility Managers (25%), and Quantity Surveyors (13%). Fifteen experts were purposively selected for qualitative interviews.

3.3 Data Collection Instruments

Primary data was collected through structured questionnaires (5-point Likert scale) and semi-structured interview guides. Secondary data was sourced from academic journals, books, and industry reports.

3.4 Data Analysis

Quantitative data was analyzed using SPSS version 26 with descriptive statistics (frequencies, percentages, means, standard deviations). Inferential statistics (ANOVA) tested differences across professional groups. Qualitative data was analyzed using thematic analysis.

IV. FINDINGS AND DISCUSSION

4.1 Demographic Profile

Of 120 respondents, 68% were male and 32% female. Eighty-five percent had over five years of experience, and 72% reported direct involvement in major building maintenance or refurbishment projects in Lagos within the last five years.

4.2 Project Speed

Eighty-seven percent of respondents agreed or strongly agreed that prefabricated systems significantly reduce construction duration (mean = 4.3). Facility managers highlighted reduced occupant displacement. One university facility manager noted: "A conventional bathroom renovation in a hostel wing disrupts 30 students for nearly two months. With a pre-fitted pod system, we could replace units floor-by-floor in a matter of days, cutting downtime by over 60%." ANOVA showed no significant difference across professional groups ($p > .05$).

4.3 Cost Efficiency

Sixty-five percent of respondents believed prefabrication offered better long-term value, while 50% identified high initial investment as a major barrier (mean for long-term cost benefit = 3.7). A quantity surveyor explained: "The unit cost of a prefabricated component is often higher. However, the true saving is systemic: near-zero material waste, drastically shorter period for skilled labour, and lower overheads." Eighty-five percent agreed material waste reduction was a major cost advantage.

4.4 Quality Control

Ninety-two percent of respondents agreed prefabrication leads to superior quality outcomes (mean = 4.5). Architects emphasized precision: "A factory-produced module delivers exact specifications with consistent quality every single time." Contractors highlighted reduced post-completion defects: "Fewer call-backs for leaks or electrical faults translates to lower liability costs."

4.5 Barriers

Major barriers identified include high capital costs, logistical transportation challenges, shortage of technical expertise, cultural resistance to new

methods, and underdeveloped regulatory frameworks.

4.6 Discussion

Findings confirm theoretical benefits of prefabrication but contextualize them within Lagos realities. Strong consensus on improved speed and quality aligns with global evidence (Blismas et al., 2006; Lawson et al., 2014). The lifecycle cost efficiency tempered by upfront capital concerns reflects documented adoption barriers (Goodier & Gibb, 2007). Local industry examples support findings: the Nigerite prototype in Ikeja demonstrates light-gauge steel panels reducing building self-weight while maintaining structural integrity; the Modular Housing Initiative in Epe completed 200 units in six months versus the two years conventional methods would require (Ogunnaike et al., 2025).

V. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Prefabricated construction systems offer substantial and demonstrable benefits for building projects in Lagos. By leveraging factory production precision and parallel workflows, prefabrication delivers faster, more durable, and ultimately more cost-effective solutions. However, realization of this potential is critically constrained by significant contextual barriers within the Nigerian construction industry.

5.2 Recommendations

- I. For University Administrations and Facility Managers: Initiate pilot demonstration projects using prefabricated systems (e.g., bathroom pods) to collect localized performance data and build internal competency.
- II. For Professional Bodies (NIA, NSE, CORBON): Develop mandatory continued professional development programs focused on DfMA principles, BIM, and management of prefabricated construction projects.
- III. For Policymakers: Review and update building codes, procurement guidelines, and approval processes to accommodate and encourage prefabricated systems. Consider fiscal incentives for projects utilizing certified local prefabricated components.

- IV. For Industry and Academia: Encourage partnerships between contractors and vocational training institutions to develop specialized skills in prefabricated component installation. Integrate industrialized construction modules into university curricula.

5.3 Suggestions for Further Studies

- I. Conduct comparative life-cycle cost analysis of prefabricated versus conventional projects
- II. Investigate logistics and supply chain models for transporting prefabricated components in Lagos
- III. Explore potential for developing local manufacturing capabilities using indigenous materials
- IV. Examine role of BIM and digital technologies in facilitating prefabricated solutions

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